Factors Influencing the Surface Strength of Coated Papers

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RETHINK PAPER:
Lean and Green

Objectives

- **To evaluate the effect of different coating color parameters on the surface strength of double coated papers in sheet-fed offset** (SFO) **printing**

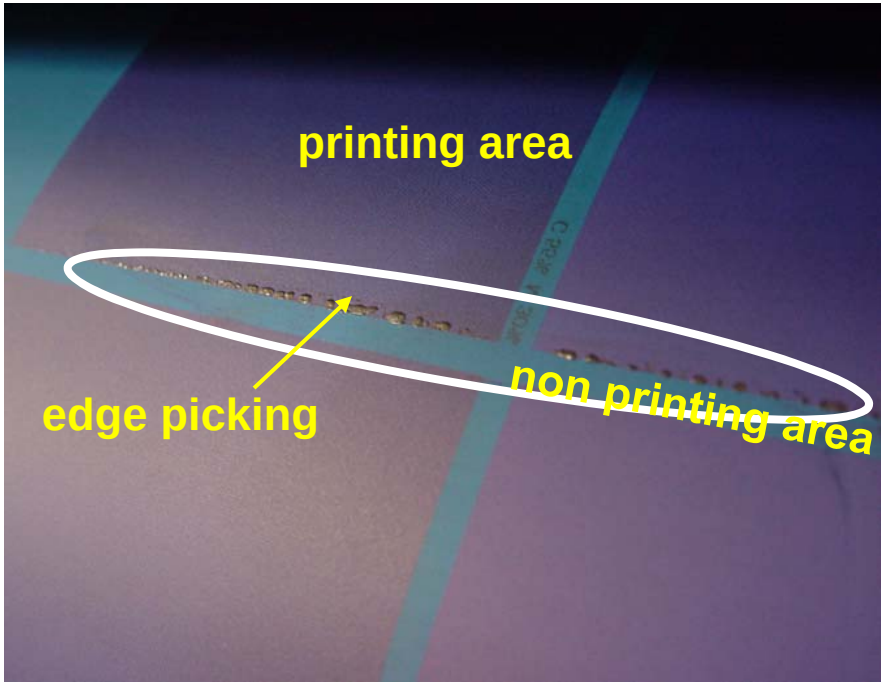
- **To correlate lab test data with observed edge picking during commercial SFO printing trials**

Background

- Latex binder is considered one of the most expensive coating components
- Continuous fine tuning of the binder level is important to cost reduction efforts – requires total systems approach
- One opportunity is to take advantage of the lower binder demand and higher solids potential of GCC
- However, the high tack inks used in SFO printing demand adequate surface strength
- Thus, a balancing act exists between optimizing coating costs and maintaining adequate coating surface strength

What is Edge Picking?

- Occurs in SFO where high-tack inks are used
- Coating is pulled out at the edge between printed and non-printed areas
- Adversely impacts print quality and leads to more frequent washing
- Excessive edge picking can damage the rubber blankets
- Thus, adequate surface strength is very important



Theoretical Considerations

- **Tack development of inks through press influenced by ink setting characteristics of coated surface**
- **Ink setting impacted by pigments and latex**
  - Fine pigments create many small pores, leading to
    - Higher capillary pressure and faster ink setting
  - Latex impact via
    - Chemistry of polymer
    - Effect on pore structure of coating layer
- **Choice of pigments and binders** (type and amount) **will greatly affect ink/coating interaction and, thus, surface strength**

Specially Designed Printing Method

- **Used redesigned printing plate and higher tack inks to exacerbate** (enhance) **edge picking.**
- **This method also involved evaluating edge picking by**
  - Visual examination of prints
  - Assessment of rubber blankets
  - Ranking edge picking between 0 (worst) and 100 (best)

Redesigned Print Test Form

short bars in 6 colors

headlines

6th unit: blue

different screens in black

short bars in 5 colors

1st unit: open area on rubber blanket

Evaluated Parameters

Pilot coater

- **Solids content of coating color**
- **Pigment type**
  GCC vs. high glossing clay
- **Pigment fineness**
  GCCs
- **Pigment psd**
  GCC: NPSD vs. BPSD
- **Latex level**
  high strength SB
- **Calendering**

Sheetfed offset press

- **Man Roland R706 Press**
- **Color sequence – KCMYCBlue**
- **Speed – 8000 iph**
- **High tack – 9.5 to 10.8**
- **High tack – 1st four units**
- **Standard tack – 7.5 to 10.0**
- **Standard tack – last 2 units**
- **Varnish unit – pressure only**

Pilot Coater Trial Program

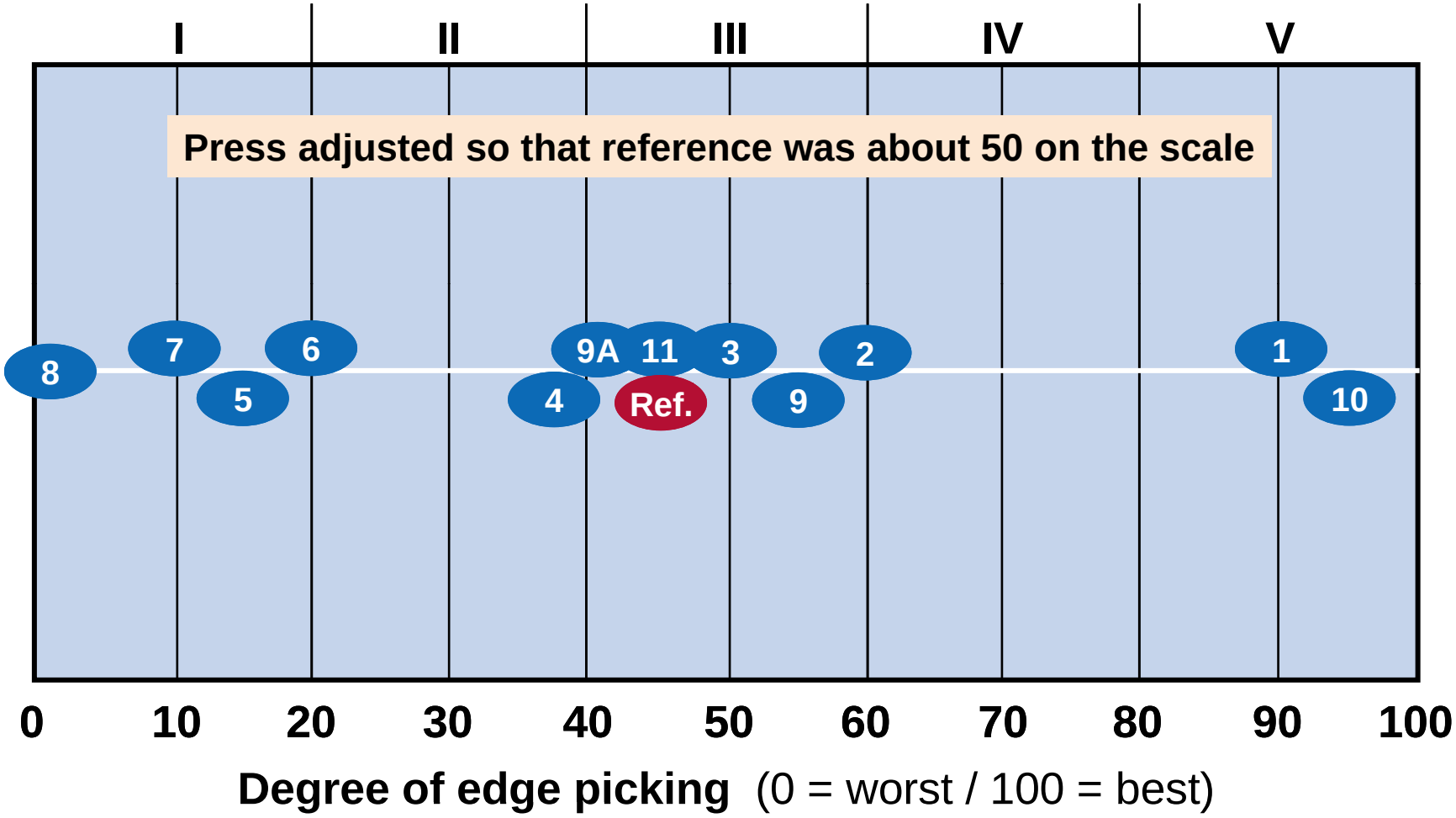
	1	2	3	4	5	6	7	8	9	10	11
GCC 95 (80 % < 1 µm)	100	100	100	100	100	100	50				
Clay (high glossing)							50	100			
NPSD GCC (75 % < 1 µm)									100		
GCC 60 (60 % < 2 µm)										100	
GCC 90 (90 % < 2 µm)											100
Latex SBR	7.5	7.5	7.5	5.0	5.0	5.0	7.5	7.5	7.5	7.5	7.5
Synthetic thickener	0.10	0.15	0.20	0.10	0.15	0.20	0.25	0.15	0.15	0.30	0.20
Solids content	71	68	65	71	68	65	65	65	68	68	68

- **Base paper: blade precoated 78 gsm**
- **Precoat – 100 GCC + starch/latex**
- **Topcoat viscosity – 1000 mPas**
- **Jet application, stiff blade 12 gsm per side of topcoat**
- **Supered to 75 gloss target**

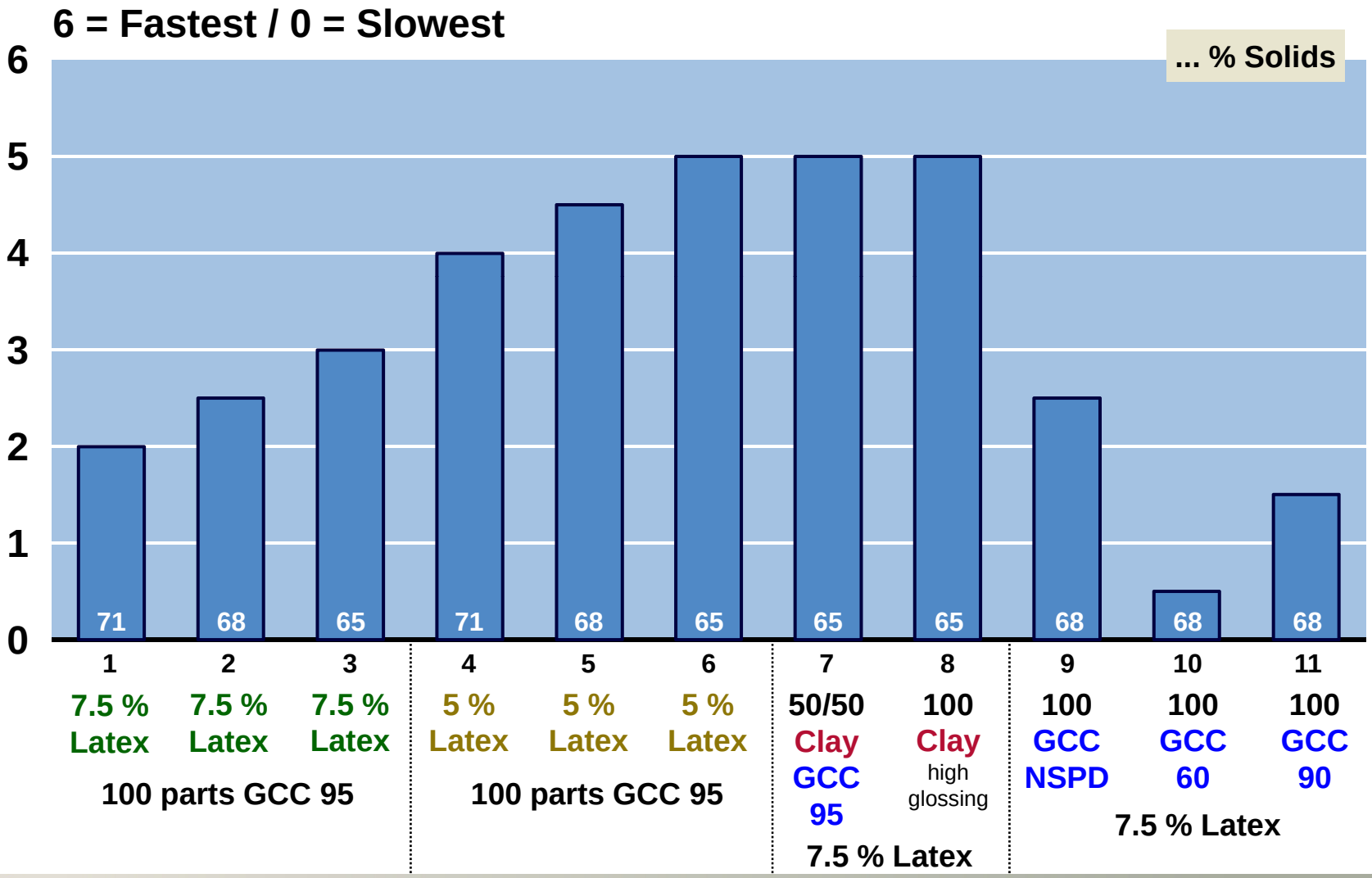
Lab Paper Testing

- **Ink set-off** — IGT – optical density – in Switzerland
- **Ink set-off** — RI Test – visual assessment – in Korea
- **Paper and Ink Stability Test** — NPA in US
- **Dry and wet pick** — Prüfbau in Switzerland and US
- **Print gloss** — Prüfbau in Switzerland and US
- **Hg intrusion porosimetry & paper opticals** — Switzerland

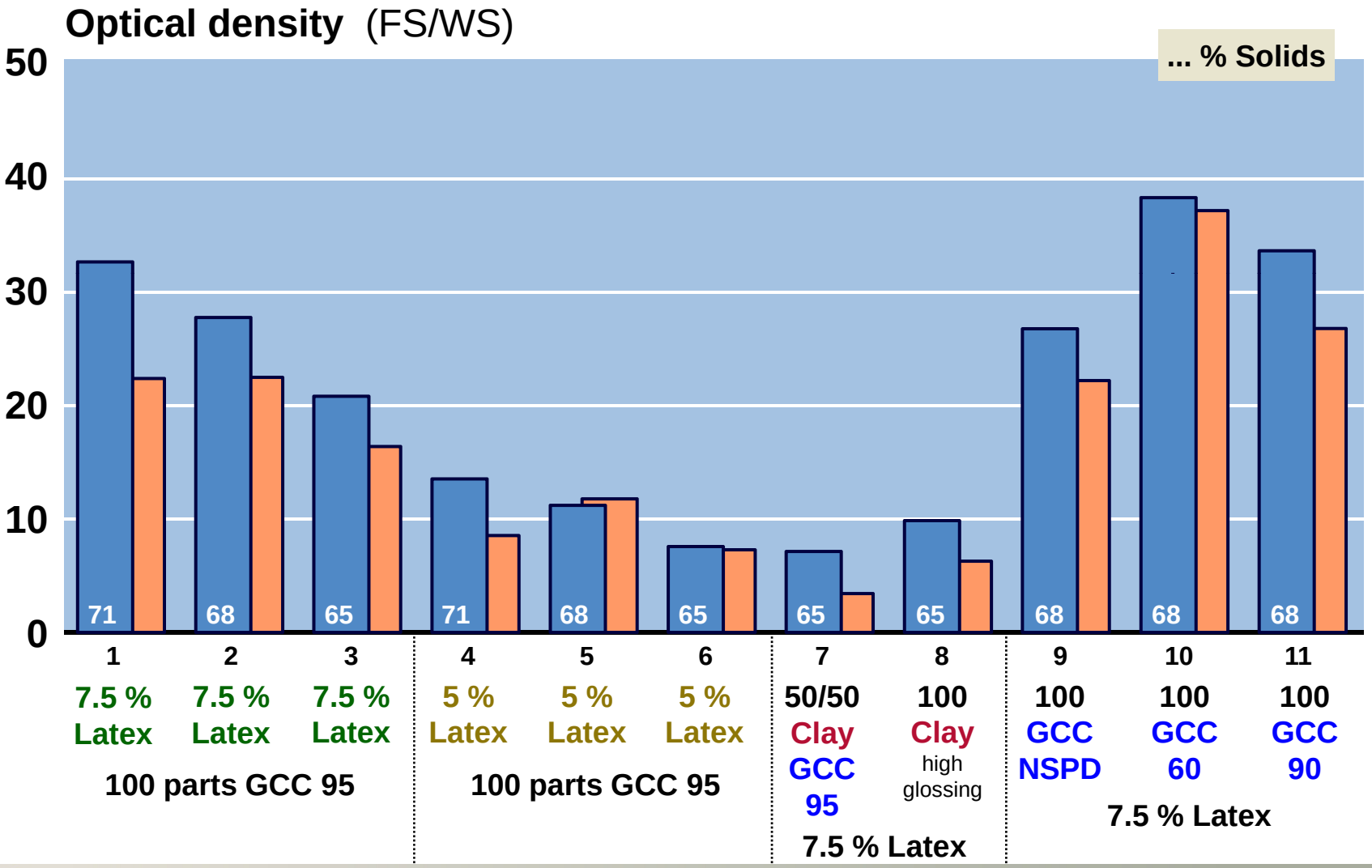
Ranking According to the Degree of Edge Picking



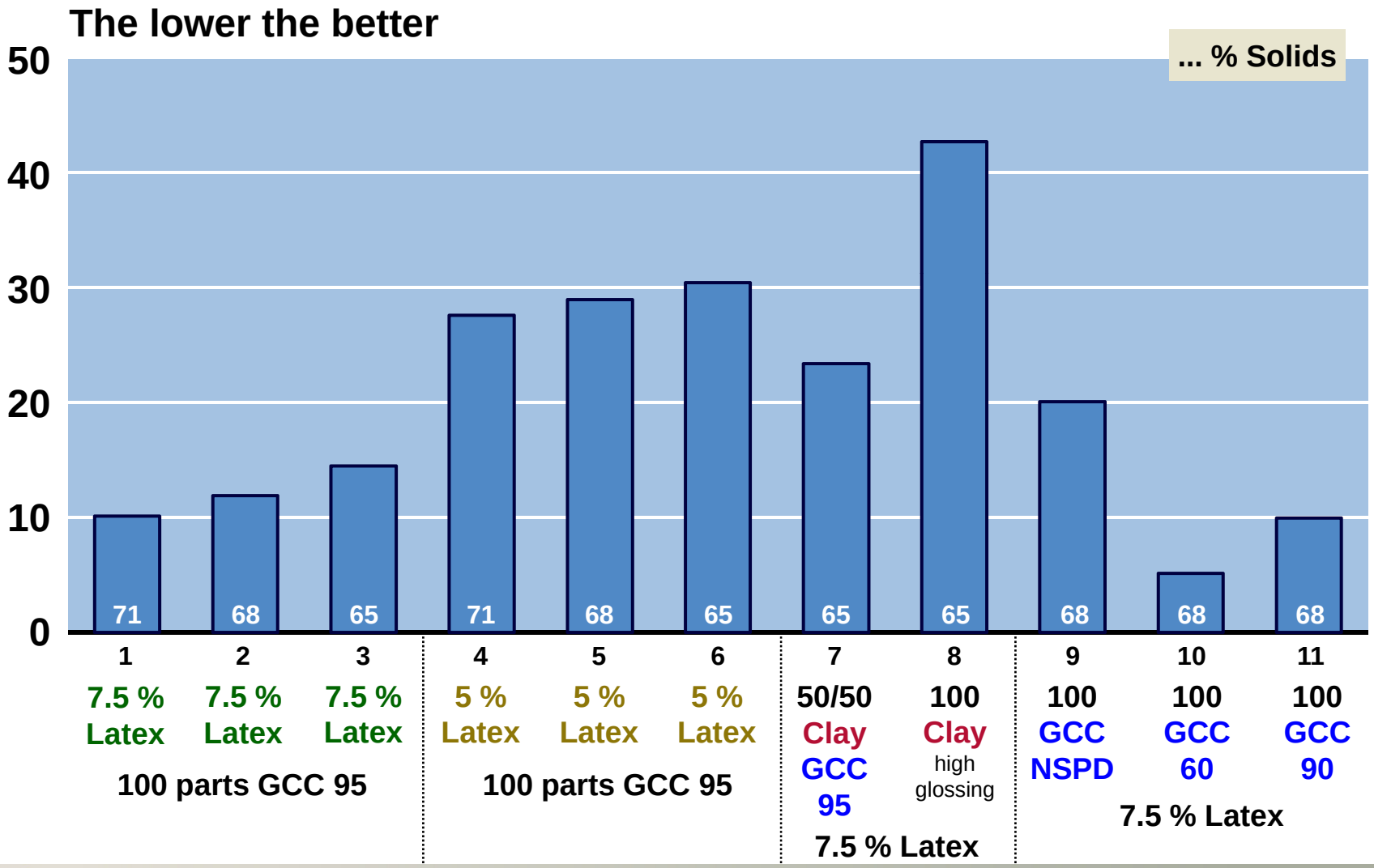
RI Ink Setting



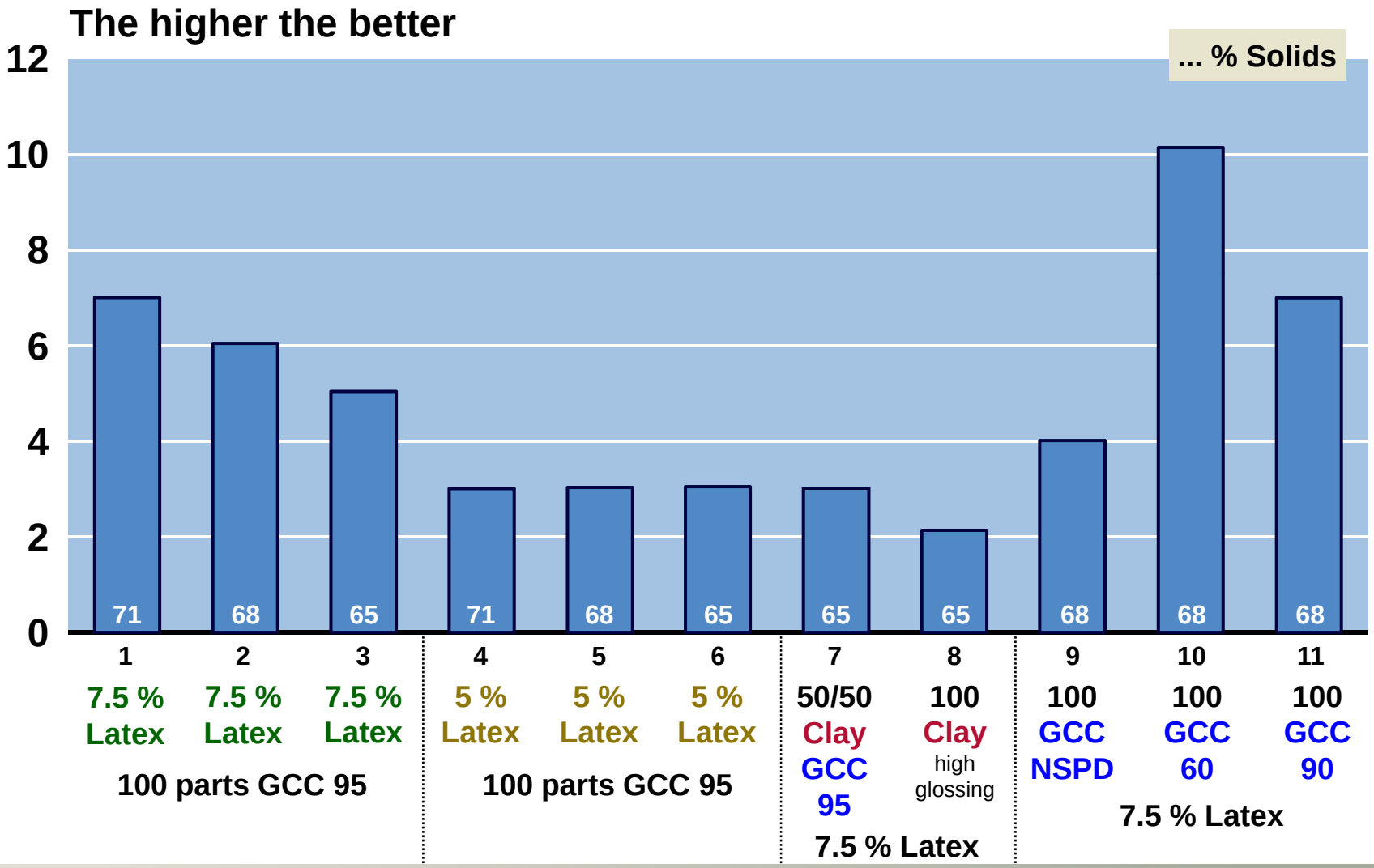
IGT Ink Setting



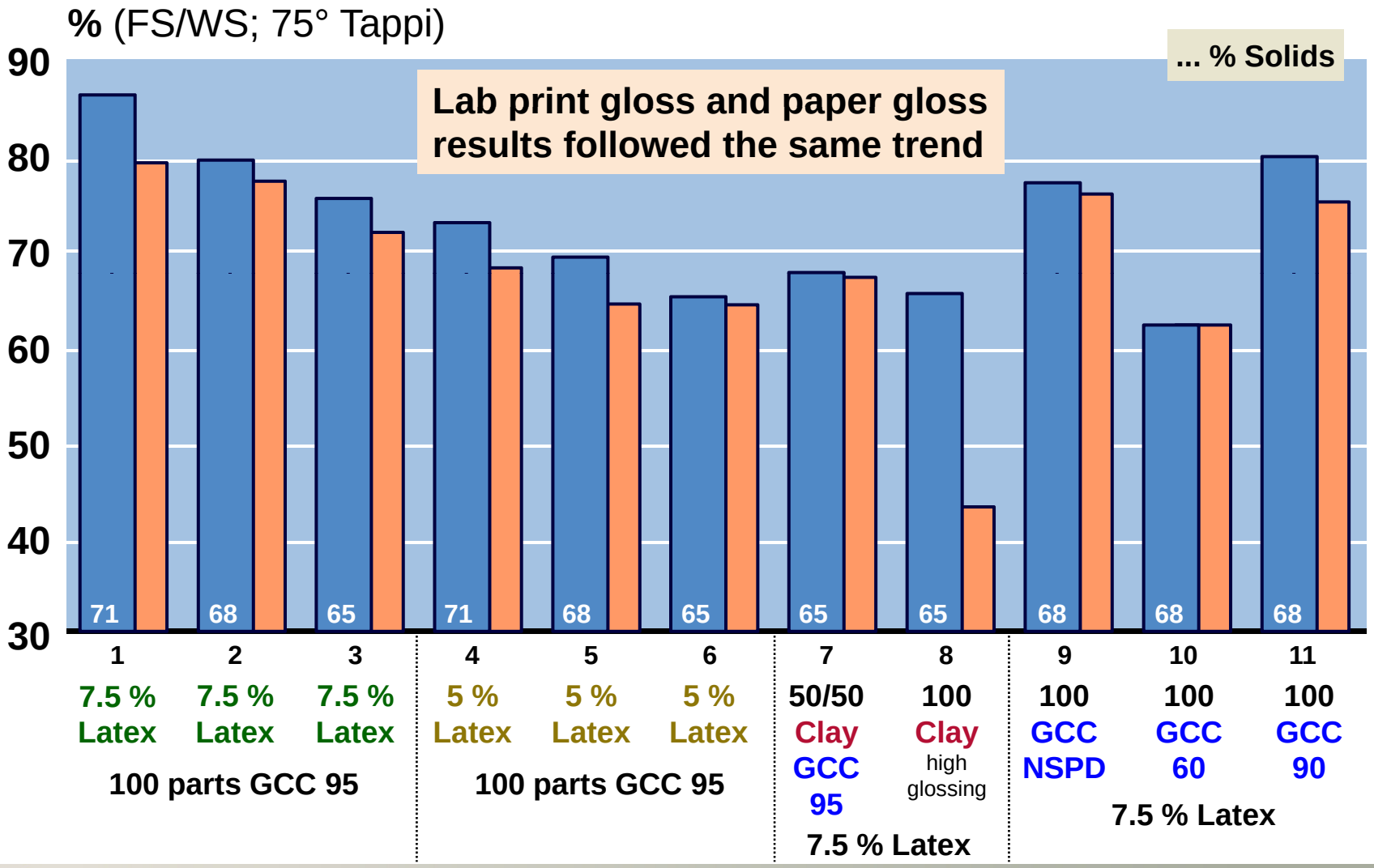
P&I Slopes


The lower the better
... % Solids
50
40
30
20
10
0
71
68
65
71
68
65
65
65
68
68
68
1
2
3
4
5
6
7
8
9
10
11
7.5 % Latex
7.5 % Latex
7.5 % Latex
5 % Latex
5 % Latex
5 % Latex
50/50 Clay GCC 95
100 Clay high glossing
100 GCC NSPD
100 GCC 60
100 GCC 90
100 parts GCC 95
100 parts GCC 95
7.5 % Latex
7.5 % Latex

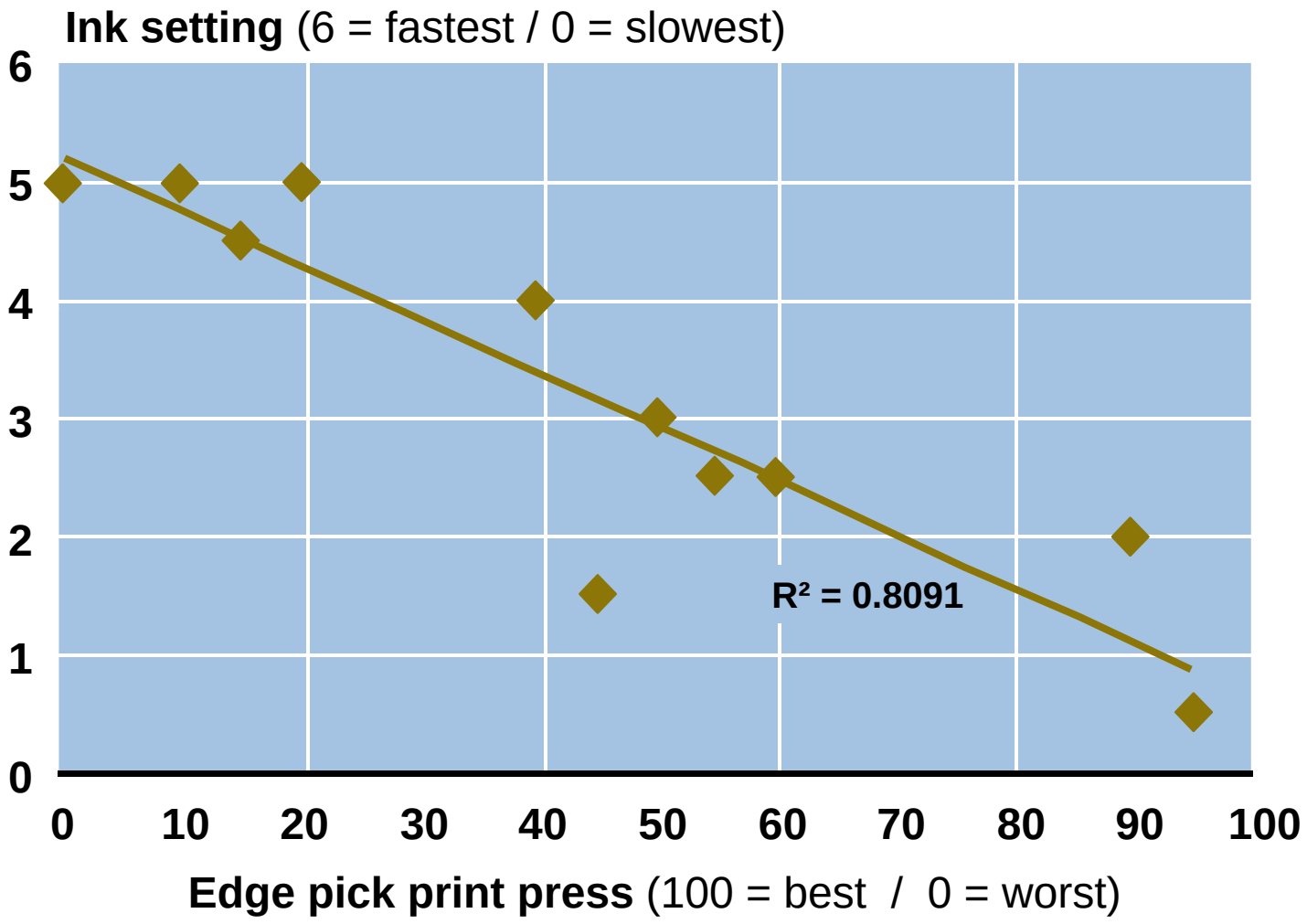
P&I Passes to Failure



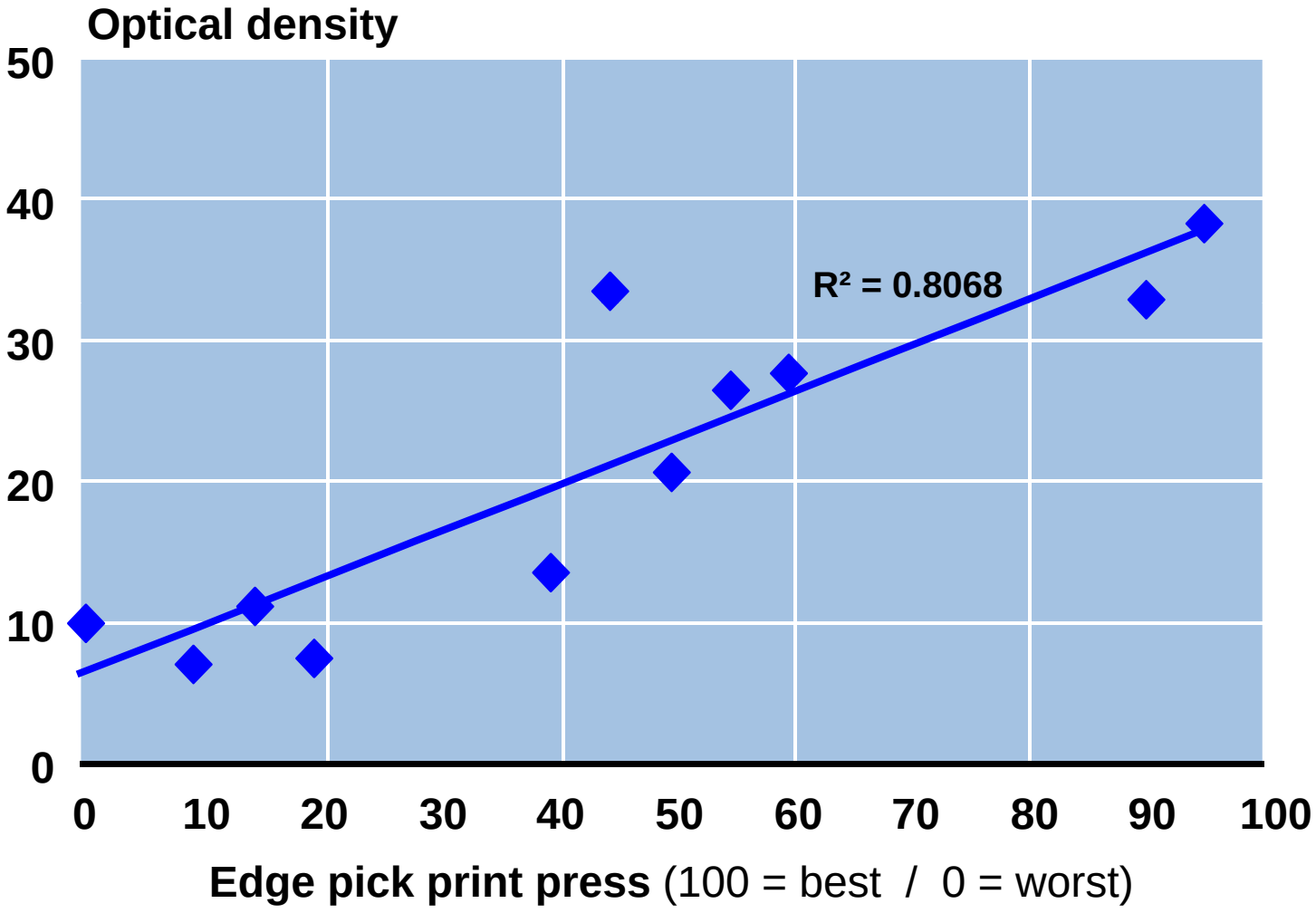
Print Gloss
commercial printed papers



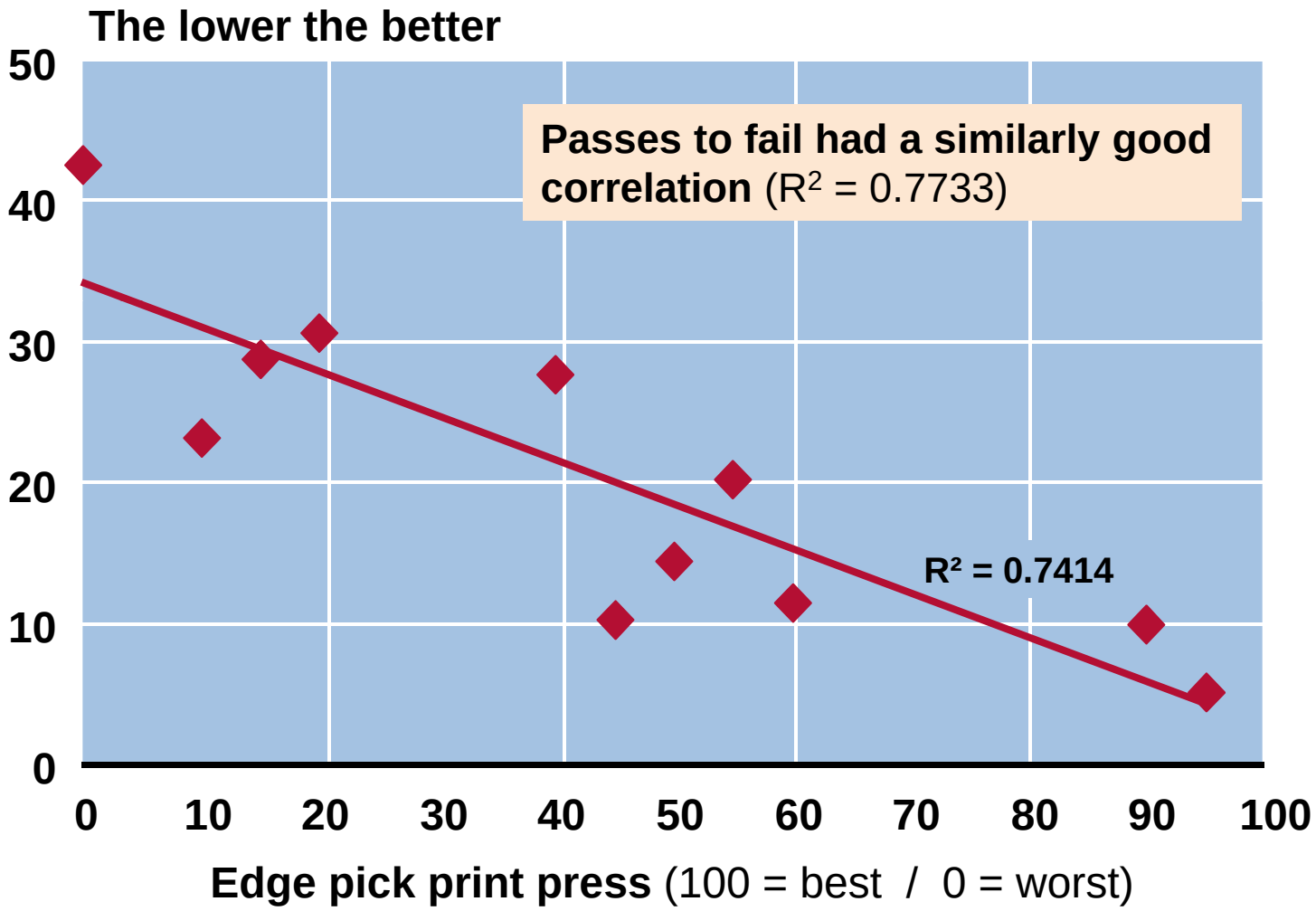
RI Test Ink Setting vs. Edge Picking



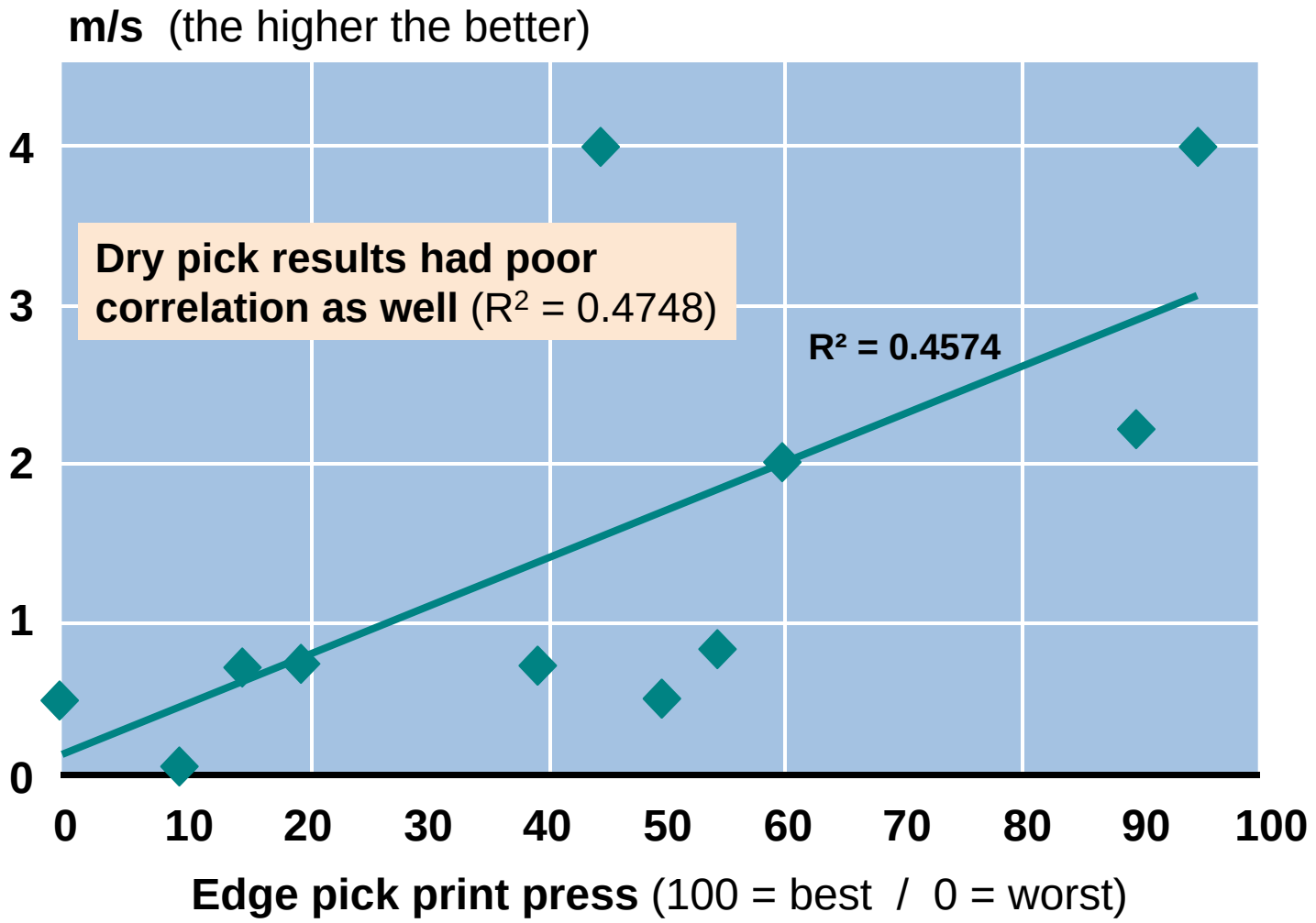
IGT Ink Setting vs. Edge Picking



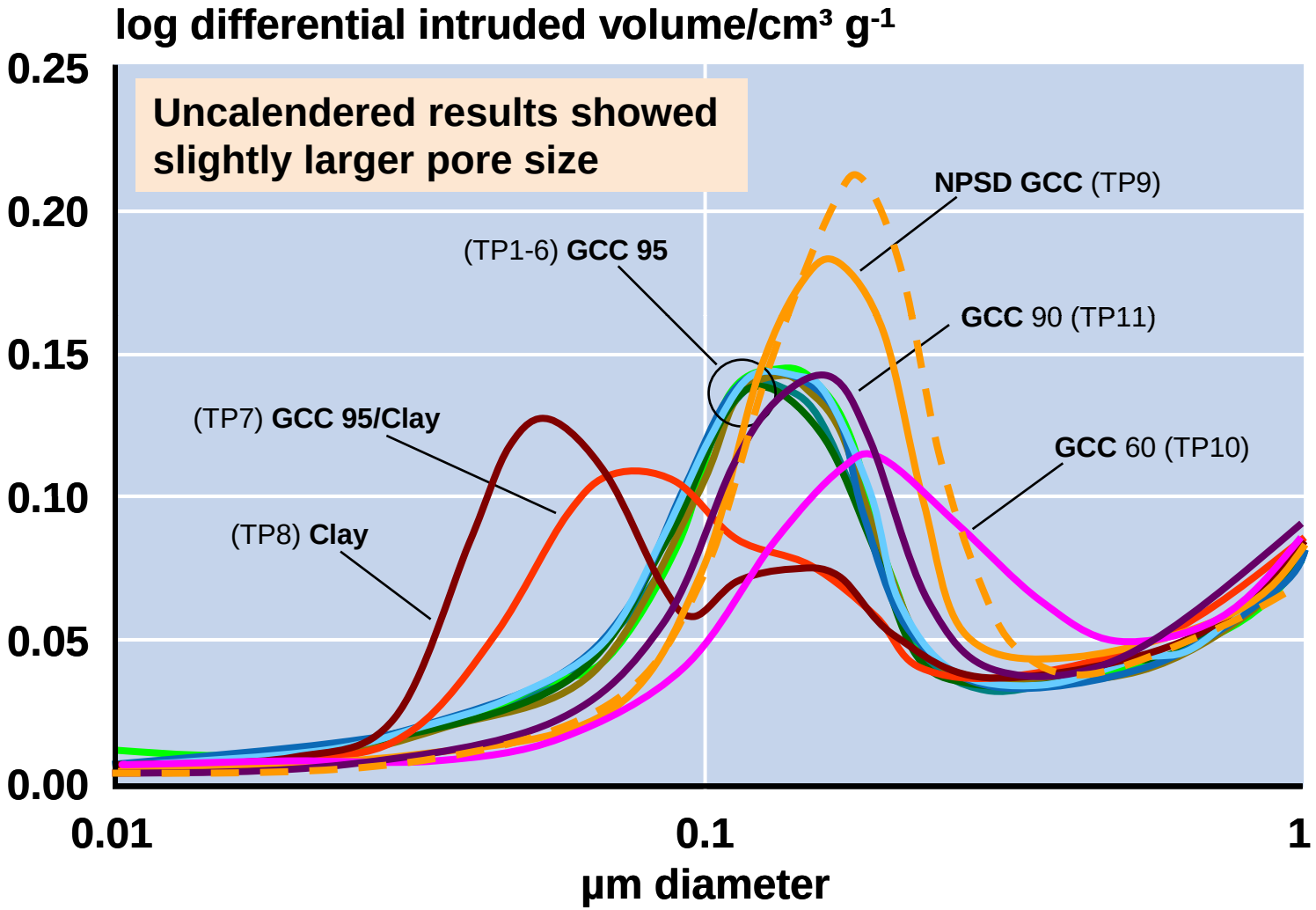
P&I Ink Tack Slope vs. Edge Picking



Wet Pick vs. Edge Picking



Pore Size Distribution - Mercury Porosimetry



Conclusions (I)

- **Specially designed commercial SFO printing method provided differentiation regarding edge picking**
- **Good correlation found between degree of edge picking and lab ink setting/tack measurements. Thus, quantifying ink/coating interaction as a function of time best "lab scale simulation" of surface strength**
- **Hg intrusion porosimetry data indicated that coating pore structure mainly depends on pigment fineness**
- **Calendering offered an improvement in surface strength**

Conclusions (II)

- **Ink setting and ink tack results indicate that pore structure of coating layer is crucial to degree of pick strength**

- **Slower ink setting favors higher surface strength via**
  - Pigments – GCC vs. clay and coarse vs. fine
  - Higher solids
  - Higher latex amount

- **Lower surface strength of clay coatings due to**
  - **Faster ink setting** (from finer pore size)
  - **Higher specific surface area** (higher binder demand)
  - **Hydrophobic nature of clay**

Conclusions (III)

- **NPSD GCC had better surface strength than expected**
- **Choice of pigments along with maximizing coating solids**
  - Allowed for reduction in binder level w/o compromising surface strength
  - Improved sheet and print gloss
- **Future work to assess further the impact of coarser clays and coating PCC**

Thank You for Your Attention!